CLAIMS

What is claimed is:

1. A splicer system for joining a first optical fiber and a second optical fiber along a common fiber axis by fusion splicing, each of said fibers being polarization-maintaining and having a discrete length and observable, internal asymmetric stress, the system comprising:

a) a user interface having an output display and user input controls for activating the splicing system;

b) an electric arc welding system;

c) holding means for rotatably holding each of said first and second optical fibers, said holding means including first and second fiber holders, each supporting said fiber for rotation in an opening having the shape of an isosceles triangle and substantially circumscribing said fiber;

d) illumination means for projecting polarized light transversely through said first and second optical fibers;

e) polarized light detection means for receiving the light passed transversely through said fibers and producing therefrom an electrically detected signal;

f) rotation means for rotating each of said first and second optical fibers about said common fiber axis;

g) measuring means for creating first and second transverse intensity functions from variations in said electrically detected signal as said first and second optical fibers are rotated;

h) lateral alignment means for laterally aligning a first end surface of said first optical fiber with a second end surface of said second optical fiber, whereby said first and second optical fibers are moved in three non-coincident directions to bring into coaxial, abutting relationship said first end surface and said second end surface to form a boundary therebetween;

i) an imaging optical system having a fiber imaging illuminator and a fiber image detector, said imaging optical system being adapted to acquire optical images of said fibers in a first imaging direction and a second imaging direction, said imaging directions being non-coincident; and

j) electronic control circuitry having:

(i) rotation analysis means in communication with said polarized light detection means for receiving said electrically detected signal to: create first and second transverse intensity functions from variations in said electrically detected signal as said first and second optical fibers are rotated; calculate a cross correlation of said first and second transverse intensity functions; a goodness of fit of each of said first and second transverse intensity functions, whereby the condition of said first and second fibers is determined; and a first

rotation correction for said first fiber and a second rotation correction for said second fiber optimal aligned position;

(ii) rotation control means in communication with said rotation means and said rotation analysis means, said rotation control means commanding said rotation means to rotate said first fiber by said first rotation correction and said second fiber by said second rotation correction, whereby said fibers are brought into azimuthal alignment;

(iii) imaging electronics that receive the output of said fiber image detector and produce a display signal feeding said output display; and

(iv) fusion control electronics operably connected to activate said electric arc welding system and supply high voltage thereto.

2. A system as recited by claim 1, wherein said first and second imaging directions are substantially mutually orthogonal.

3. A system as recited by claim 1, wherein each of said imaging directions is substantially orthogonal to said common fiber axis.

4. A system as recited by claim 1, wherein said fiber image detector comprises a single imaging device.

5. A system as recited by claim 1, wherein said fiber image detector comprises a charge-coupled device.

6. A system as recited by claim 1, wherein said electronic control circuitry further comprises a profile alignment system in communication with said fiber image detector and said lateral alignment means, and said profile alignment system is

adapted to automatically command said lateral alignment means to bring said fibers into alignment prior to said fusion.

7. A system as recited by claim 1, wherein:

a) said fusion splicing head further comprises a low profile local injection and detection system including:

(i) a light injector adapted to inject light into said first fiber;

(ii) and a light detector detecting light in said second fiber; and

(iii) wherein said local injection and detection system provides an electronic intensity signal indicative of the fraction of said injected light propagated across the interface between said fibers;

b) said electronic control circuitry further comprises:

(i) a driver energizing said light injector and measurement electronics connected to said light detector receiving and processing said electronic intensity signal to provide a measured intensity signal;

(ii) a servo system operative to drive said motion means to maximize said measured intensity signal, whereby the relative position of said fibers is optimized prior to fusion thereof.

8. A system as recited by claim 1, further comprising writeable data storage means adapted to store and transfer data associated with the operation of said splicing system.

9. A system as recited by claim 1, wherein said user input controls comprise control buttons.

10. A system as recited by claim 1, wherein said user input controls comprise a touch screen.

11. A method for joining a first optical fiber and a second optical fiber along a common fiber axis, said fibers maintaining polarization, and the method comprises:

a) providing a fusion splicing system, the system comprising:

(i) a user interface having an output display and user input controls for activating the splicing system;

(ii) an electric arc welding system;

(iii) holding means for rotatably holding each of said first and second optical fibers, said holding means including first and second fiber holders, each supporting said fiber for rotation in an opening having the shape of an isosceles triangle and substantially circumscribing said fiber;

(iv) illumination means for projecting polarized light transversely through said first and second optical fibers;

(v) polarized light detection means for receiving the light passed transversely through said fibers and producing therefrom an electrically detected signal;

(vi) rotation means for rotating each of said first and second optical fibers about said common fiber axis;

(vii) measuring means for creating first and second transverse intensity functions from variations in said electrically detected signal as said first and second optical fibers are rotated;

(viii) lateral alignment means for laterally aligning a first end surface of said first optical fiber with a second end surface of said second optical fiber, whereby said first and second optical fibers are moved in three non-coincident directions to bring into coaxial, abutting relationship said first end surface and said second end surface to form a boundary therebetween;

(ix) an imaging optical system having a fiber imaging illuminator and a fiber image detector, said imaging optical system being adapted to acquire optical images of said fibers in a first imaging direction and a second imaging direction, said imaging directions being non-coincident; and

(x) electronic control circuitry having: rotation analysis means in communication with said polarized light detection means for receiving said electrically detected signal to: create first and second transverse intensity functions from variations in said electrically detected signal as said first and second optical fibers are rotated; calculate a cross correlation of said first and second transverse intensity functions; a goodness of fit of each of said first and second transverse intensity functions, whereby the condition of said first and second fibers is determined; and a first rotation correction for said

first fiber and a second rotation correction for said second fiber optimal aligned position; rotation control means in communication with said rotation means and said rotation analysis means, said rotation control means commanding said rotation means to rotate said first fiber by said first rotation correction and said second fiber by said second rotation correction, whereby said fibers are brought into azimuthal alignment; imaging electronics that receive the output of said fiber image detector and produce a display signal feeding said output display; and fusion control electronics operably connected to activate said electric arc welding system and supply high voltage thereto;

b) preparing said first and second optical fibers by removing coatings present thereon and cleaving the ends of the fibers to form a mating end on each fiber;

c) mounting said first and second optical fibers in said holding means;

d) laterally aligning said first and second optical fibers in coaxial, abutting relationship;

e) rotating said first fiber to create a first transverse intensity function and said second fiber to create a second transverse intensity function, each of said functions being created from variations in said electrically detected signal;

f) calculating a cross-correlation function of said first and second transverse intensity functions, a maximum of said cross-correlation

function a goodness of fit of each of said first and second transverse intensity functions, and a first rotation correction for said first fiber and a second rotation correction for said second fiber, said rotation corrections together corresponding to said maximum;

g) rotating said first fiber by said first rotation correction and said second fiber by said second rotation correction to bring said fibers into azimuthal alignment; and

h) fusing said fibers by electric arc welding.